Seasonal prediction of the intraseasonal variability of the West African summer monsoon precipitation

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1. Introduction

- Seasonal prediction is probabilistic in nature
- Dynamical forecast systems have substantial systematic errors
- Important to quantify the main sources of uncertainty
  - Initial conditions → Ensemble forecast
  - Model inadequacy → Multi-model ensemble forecast
- West African monsoon (WAM) is one of the most challenging climate problem because of high mortality risks due to extreme and persistent droughts

2. Objectives

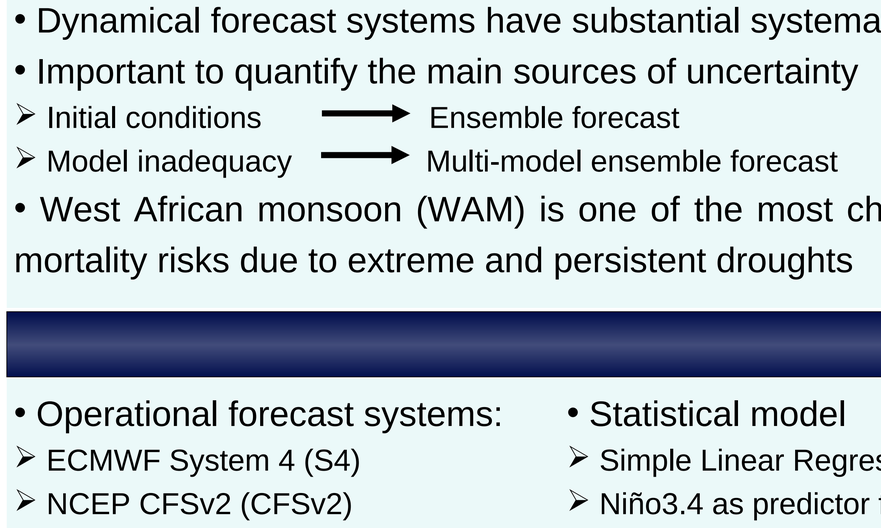
- Combine the ECMWF System 4, the NCEP CFSv2, the Météo-France System 3 and a simple statistical model to predict the two main modes of the WAM rainfall variability: Guinean and Sahelian regimes
- Assess the deterministic and probabilistic forecast quality of the single forecast systems and their combinations. This is performed in an operational forecasting context

3. Data and methods

- Operational forecast systems:
  - ECMWF System 4 (S4)
  - NCEP CFSv2 (CFSv2)
  - Météo-France System 3 (MF3)
- Statistical model
  - Simple Linear Regression, SST as predictor
  - Niño3.4 as predictor for the Guinean rainfall regime
  - AMO as predictor for the Sahelian rainfall regime
  - First training period: 1951 - 1981, adding a new year at a time
  - Target period: 1982 - 2010
  - ERSST and GPCC were used to train the statistical model
- GPCP was used as the reference dataset for the verification assessment
- Monthly rainfall was averaged zonally over 10ºW-10ºE to assess both the role of the latitudinal migration and the intraseasonal distribution of rainfall on the WAM rainy season
- Principal component analysis to estimate the modes of variability: Guinean and Sahelian rainfall regimes

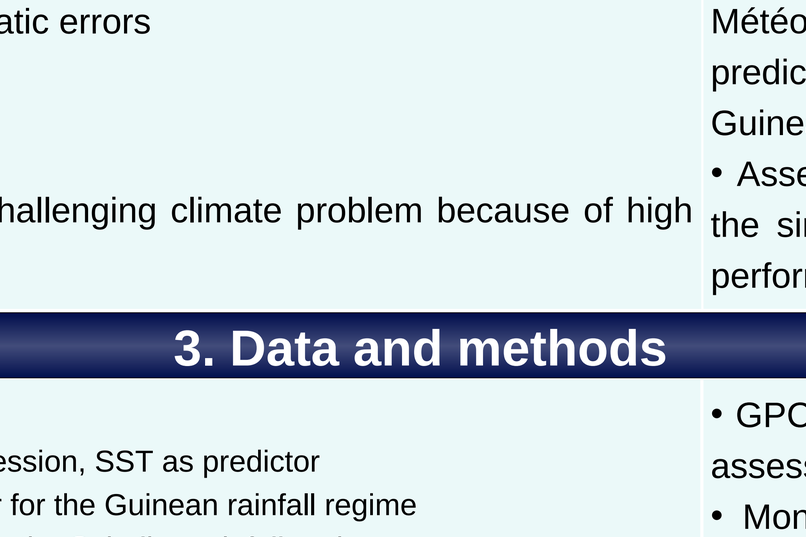
4. Modes of WAM rainfall variability

Observed Empirical Orthogonal Function



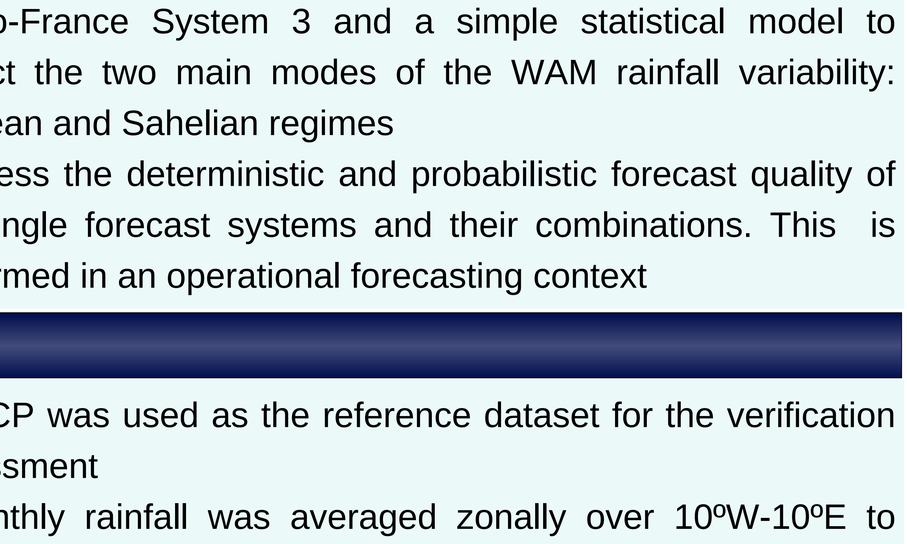
- GPCP EOF1, GPCP land-only and GPCC EOF2 represent the Guinean rainfall regime
- GPCP EOF2, GPCP land-only and GPCC EOF1 represent the Sahelian rainfall regime

Observed Principal Component



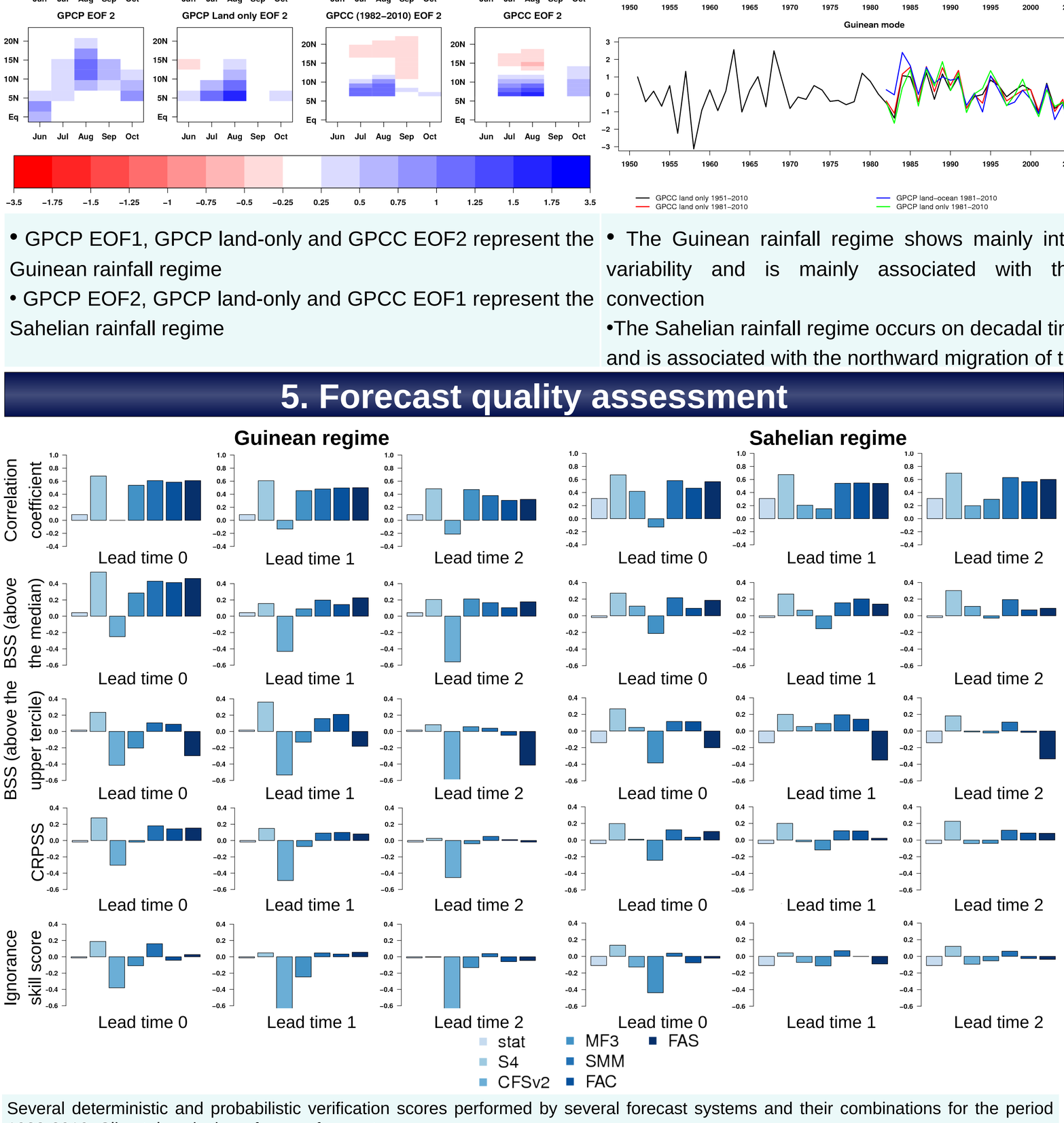
- The Guinean rainfall regime shows mainly interannual variability and is mainly associated with the ITCZ convection
- The Sahelian rainfall regime occurs on decadal timescales and is associated with the northward migration of the ICTZ

Predicted Empirical Orthogonal Function



- The three operational forecast systems are able to capture the main features associated with the two leading modes of WAM rainfall variability

5. Forecast quality assessment



Several deterministic and probabilistic verification scores performed by several forecast systems and their combinations for the period 1982-2010. Climatology is the reference forecast.

6. Conclusion

- S4, CFSv2 and MF3 are able to capture the main features associated with the two leading modes of WAM rainfall variability
- However, all these operational dynamical forecast systems have substantial systematic error (not shown)
- S4 has relatively high correlation when predicting the two leading modes of WAM rainfall variability and MF3 when predicting the Guinean regime. On the other hand, CFSv2 has low correlation when predicting the Guinean and Sahelian regimes
- All probabilistic scores show a similar conclusion: only S4 consistently beats the probabilistic climatological forecast
- S4 outperforms all single forecast systems and combinations

7. Future work

- This study will be extended to the spatial analysis of the monthly-mean two-meter temperature and precipitation predictions in the Mediterranean region

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